N91-14998

STOCHASTIC HISTORIES OF DUST GRAINS IN THE INTERSTELLAR MEDIUM

K. Liffman* and D.D. Clayton**
*NASA Ames Research Center, MS 245-3, Moffett Field, California, 94035 USA
**Dept. of Space Physics and Astronomy, Rice University, P.O. Box 1892 Houston, Texas, 77251 USA

The purpose of this paper is to study an evolving system of refractory dustgrains within the Interstellar Medium (ISM). This is done via a combination of Monte Carlo processes and a system of partial differential equations, where refractory dust grains formed within supernova remnants and ejecta from high mass loss stars are subjected to the processes of sputtering and collisional fragmentation in the diffuse media and accretion within the cold molecular clouds. In order to record chemical detail, we take each new particle to consist of a superrefractory core plus a more massive refractory mantle. The particles are allowed to transfer to and fro between the different phases of the ISM - on a time scale of 10^8 years - until either the particles are destroyed or the program finishes at a Galaxy time of 6×10^9 years. The resulting chemical and size spectrum(s) are then applied to various astrophysical problems with the following results:

(1) for an ISM which has no collisional fragmentation of the dust grains, roughly 10% by mass of the most refractory material survives the rigors of the ISM intact, which leaves open the possibility that 'fossilized' isotopically anomalous material may have been present within the primordial solar nebula.

(2) structured or layered refractory dust grains within our model cannot explain the observed interstellar depletions of refractory material (see fig. 1.).

&(3) fragmentation due to grain-grain collisions in the diffuse phase plus the accretion of material in the molecular cloud phase can under certain circumstances cause a bimodal distribution in grain size (see fig. 2.)

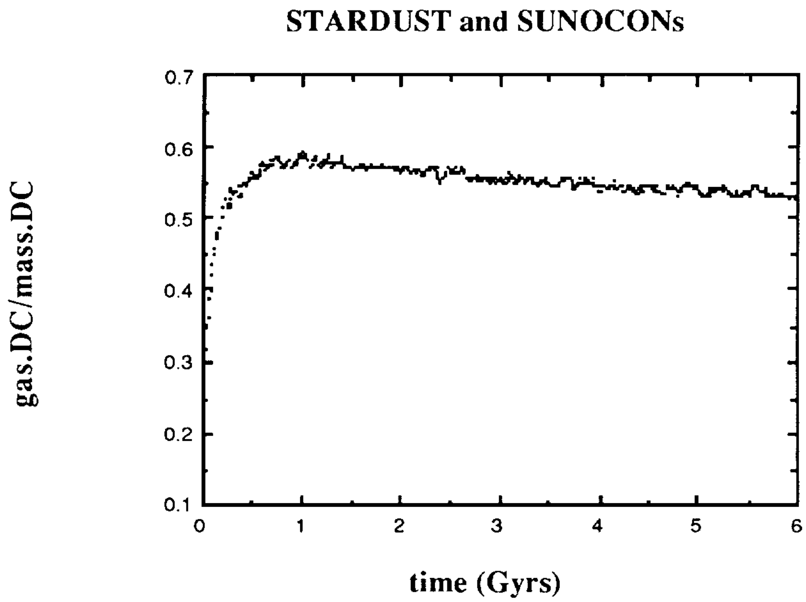

Fig. 1. The ratio of the mass of condensible gas in the diffuse medium to the total mass of the diffuse medium. As can be seen, refractory material is not sgnificantly depleted in the diffuse phase.

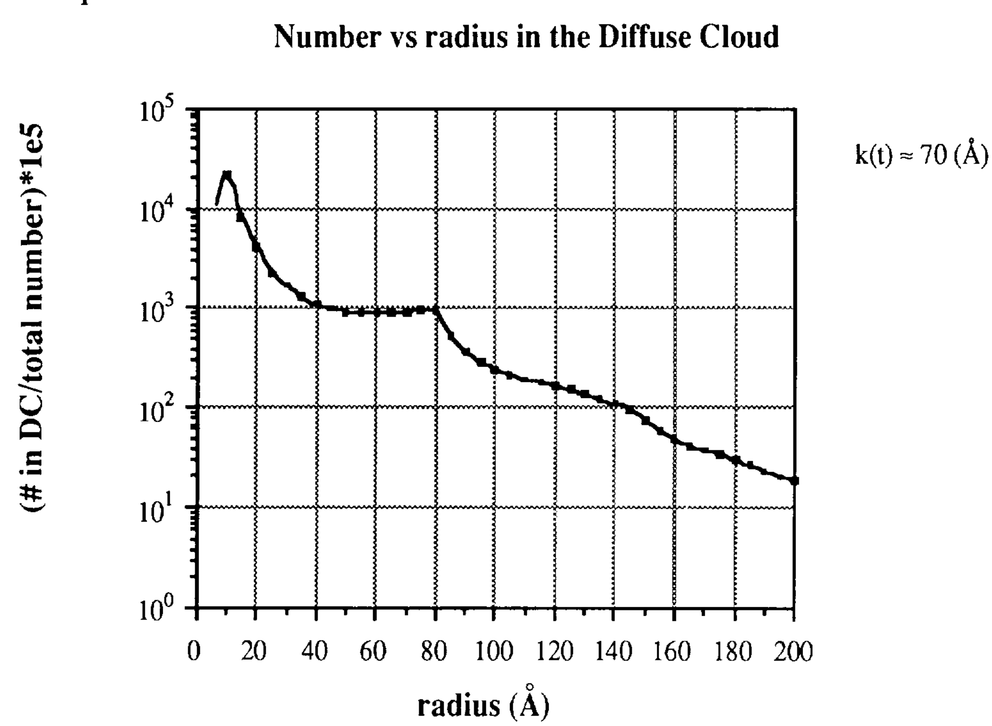

Fig. 2: Number of particles in the Diffuse Cloud over the total number of particles in the ISM versus the radii to the particles. The symbol k(t) refers to the thickness of the accreted mantle, which is a function of time.